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The Impact of Financial Crisis in Coronary Artery Disease Burden in Greece

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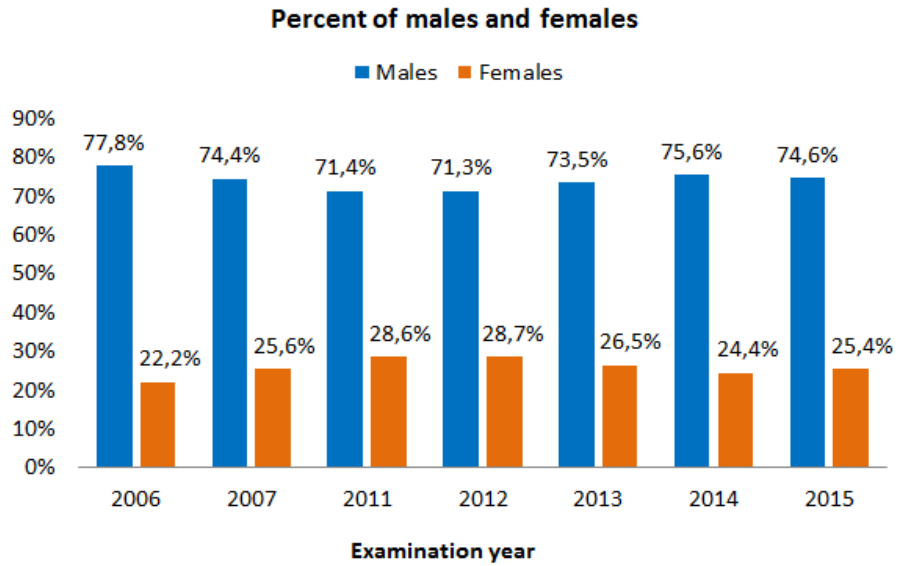
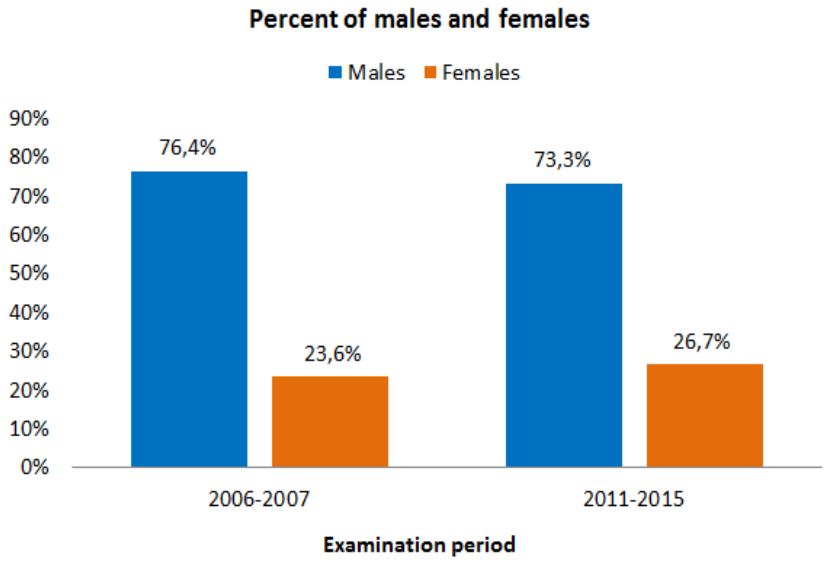
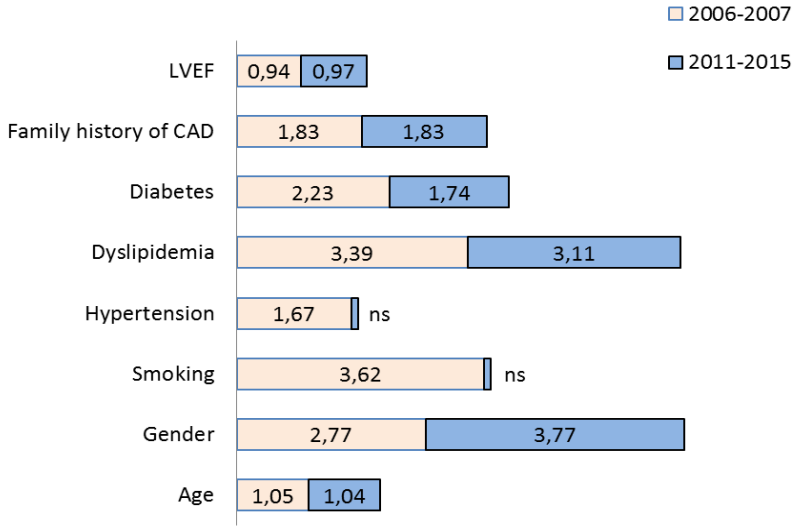




A statistically significant increase in the percent of examined females was observed during the period 2011-2015 compared to 2006-2007 (26.7% vs 23.6%, p=0.038).



Odds ratios of independent risk factors associated with positive coronary artery disease findings for the two periods 2006-2007 and 2011-2015.

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The Impact of Financial Crisis in Coronary Artery Disease Burden in Greece

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Abstract

Background. Economic crisis poses an immense threat to public health worldwide and has been linked to cardiovascular morbidity and mortality. Greece is facing a distinctive recession over the recent years. However, the exact impact on coronary artery disease (CAD) burden has not been adequately addressed.

Methods. Demographic, clinical and angiographic data of 3895 hospitalized patients were retrospectively studied. Patients were classified in those before crisis (2006-2007, n=1228) and those during crisis (2011-2015, n=2667).

Results. All data before and during crisis were compared. During crisis, patients presented with less acute coronary syndromes (ACS - 45.5% vs 39.9%, p<0.001). Subsequently, there were more patients without CAD (23.7% vs 35.1%, p<0.001) or one vessel disease (20.5% vs 23%, p<0.001). The prevalence of traditional risk factors decreased significantly or remained stable except obesity (26.3% vs 31.4%, p=0.002). A significant increase of the examined females (23.6% vs 26.7%, p=0.04) was also observed.

Conclusions. The extend of CAD during financial crisis was partially affected. Even though the incidence of ACS was decreased, more women and more patients with no or single vessel disease were led for cardiac catheterization. In addition, the prevalence of traditional risk factors for CAD did not increase except obesity confirming the “obesity paradox”. It seems that the impact of traditional risk factors for CAD is not an immediate process and is somewhat related to living conditions or other exogenous and social factors.

Introduction

Financial crisis poses an immense threat to public health worldwide and has been linked to cardiovascular morbidity and mortality [1-3]. Greece is facing a distinctive recession over the last decade. However, the exact impact on coronary artery disease (CAD) burden along with the possible negative health outcomes have not been adequately addressed yet [4].

Historically, the major risk factors for cardiovascular disease include advancing age, male gender, positive family history for premature CAD, smoking, hypertension, lipid abnormalities, glucose metabolism disorders and obesity [5, 6]. These factors cluster and interact multiplicatively to promote vascular risk [7]. In addition, the specific role of each factor has been incorporated in the development of several multivariable risk prediction algorithms conducing to assess the risk of disease in individual patients [8, 9]. Knowing the exact profile of each catheterized patient (the number and the type of vessels diseased) we can obtain substantial prognostic information for the outcome of CAD. Thus, it is of great importance to determine the exact relationship between the clinical profile and the angiographic characteristics [10].

The principal aim of the current study was to investigate the imminent impact of economic crisis on patients who underwent diagnostic cardiac catheterization and to observe any potential changes in the trends and the severity of the established cardiovascular risk factors.

Methods

Study Population. Within two distinct periods of time namely 2006 to 2007 and from 2011 to 2015, 3895 patients in total were subjected to heart catheterization

due to typical or atypical clinical symptoms according to the records of Laiko General Hospital of Athens, Greece and were classified in two groups, the group before financial crisis (2006-2007, n=1228) and the group during crisis (2011-2015, n=2667). Angiographic evaluation included a mandatory diagnostic coronary angiography according to standard techniques for all incoming patients and, if necessary, a percutaneous coronary intervention (PCI). Before examination a detailed coronary risk profile for every patient was obtained as well as valid height and weight measurements. The present study was approved by the Medical Research Ethics Committee of our Institution and was carried out in accordance with the declaration of Helsinki of the World Medical Association.

Definitions. Family history for premature CAD was considered positive when there was a history of coronary manifestation in first-degree relatives before the age of 55 for males and before the age of 65 for females. Dyslipidemia was defined by total cholesterol levels >200 mg/dL and/or low-density lipoprotein cholesterol levels >130 mg/dL and/or high-density lipoprotein cholesterol levels <40 mg/dL for men and <50 mg/dL for women and/or triglyceride levels >150 mg/dL or current use of anti-dyslipidemic agents. Patients that took antihypertensive medications or their blood pressure levels were ≥140/90 mmHg were defined as hypertensive. Diabetes mellitus (DM) was defined by fasting plasma glucose levels ≥126 mg/dL or 2-hour values in the oral glucose tolerance test ≥200 mg/dL or levels of isolated elevation of glycated hemoglobin ≥6.5% or current use of insulin or other oral hypoglycemic agents. Current smokers were defined those that smoked at least one cigarette per day and non-smokers those who did not smoke and/or had quit smoking for at least one year. Body mass index (BMI) was calculated as bodyweight in kilograms divided

by height in meters squared and was estimated for all patients. Obesity was defined as BMI ≥30 kg/m^2.

Statistical analysis. Continuous variables were expressed as mean values ± standard deviation (SD). Comparisons of continuous variables were performed by one-way analysis of variance (ANOVA). Categorical data were expressed as absolute and relative frequencies. Multivariable logistic regression analysis was performed to examine the predictive value of the risk factors that are independently related to the presence of CAD. All data were analyzed using Statistical Package for the Social Sciences (SPSS) version 18.0 and all tests were 2-tailed with the 5% indicating level of significance.

Results

Demographic and clinical characteristics. A total of 3895 patients were angiographically evaluated for clinically suspected CAD. During crisis, less patients with ACS (45.5% vs 39.9%, p<0.001) were presented compared to the pre-crisis period. Even though the predominance of men over women was verified in both of the examined periods (76.4% vs 73.3%, p=0.04) there was a significant increase of the examined females (23.6% vs 26.7%, p=0.04) during crisis. Risk factors including family history of CAD (17.7% vs 13%, p<0.001), smoking (45.4% vs 36.9%, p<0.001), hypertension (69.2% vs 60%, p<0.001) and dyslipidemia (59% vs 48.1%, p<0.001) were significantly decreased while the incidence of DM remained practically stable (28.4% vs 27.2%, p=0.44). Conversely, only obesity was considerably more prevalent (26.3% vs 31.4%, p=0.002). Data are presented in Table 1.

Comparing patients with CAD before and during crisis a significantly lower prevalence of all risk factors except DM was observed. Hypertension and dyslipidemia were also reduced in those without CAD, but the differences were not statistically significant. Nevertheless, only obesity was significantly increased in all patients with or without CAD during economic downturn (Table 2).

Angiographic characteristics. The number of patients without CAD (23.7% vs 35.1%, p<0.001) was increased during financial crisis. Furthermore, more individuals with one vessel disease (20.5% vs 23%, p<0.001) and less with two (20.2% vs 18.9%, p<0.001) or three vessels disease (35.6% vs 23%, p<0.001) were examined (Table 3).

Multivariable Analysis. According to the multiple logistic regression analysis, male gender (OR=3.77, CI=2.68-5.30), dyslipidemia (OR=3.11, CI=2.26-4.28), family history (OR=1.83, CI=1.16-2.89) and DM (OR=1.74, CI=1.21-2.51) were significantly associated with CAD during financial crisis. Before crisis, this correlation was slightly different with smoking (OR=3.62, CI=2.51-5.21) to be considered as the strongest predictive factor (Table 4).

Discussion

This study showed that the burden of CAD in Greece during financial crisis was partially affected. Even though the incidence of ACS was decreased, more women and more patients with no or single vessel disease were led for cardiac catheterization. Moreover, the prevalence of traditional risk factors for CAD was reduced or remained stable except obesity confirming the “obesity paradox”.

Lower socioeconomic status leads to higher rates of morbidity and mortality [11, 12]. This relationship is particularly evident in the case of CAD [13]. A cross-

sectional study that was conducted to explore the current economic status of patients with CAD revealed that most of the patients categorized in low income level [14]. In addition, the PURE study that included citizens of 17 countries showed that the rates of ACS were substantially higher in low income countries [15]. The results of the present study suggest that the prolonged financial downturn might have led to fewer patients with ACS. Furthermore, there were more patients without CAD or with one vessel CAD whereas the incidence of complex CAD was reduced, presumably because the majority of individuals presented with atypical symptoms or stable CAD during crisis. Nevertheless, these patients were subjected to earlier diagnostic catheterization and, if necessary, PCI.

Although CAD is mainly considered as men's disease, more women die annually mainly due to the specific pathology differences of atherosclerosis [16, 17]. Females have a lower burden of obstructive CAD and a higher prevalence of angina [18].They are also two to three times more likely than men to experience a cardiac event and have persistent chest pain symptoms within the first year following cardiac catheterization [19]. Additionally, females with CAD are often less symptomatic or have atypical symptoms emphasizing the need for gender-specific approaches to CAD evaluation [20, 21]. Low socioeconomic status might also contribute to negative health outcomes for women. Indeed, women with low socioeconomic status are at significant greater risk of CAD compared with men according to a recent meta-analysis [22]. In the current study, there was a significant increase of the examined females during economic downturn compared with the previous period of time. Consequently, the increasing awareness among physicians and general population about clinical characteristics of female individuals with CAD might explain this observation. To the best of our knowledge this is the first study in Greek population

that revealed an increase in the percentage of women that was evaluated for clinically suspected CAD.

It is well established that the higher the BMI, the greater the risk of cardiovascular diseases [23, 24]. However, a lot of studies have underlined the paradoxical relationship between obesity and cardiovascular prognostic outcomes in large number of patients [25, 26]. Lancefield et al in 2010 showed that overweight and obese patients had a lower in-hospital and 1-year mortality rate after PCI compared to normal weight patients [27]. The term used to describe this relationship is “obesity paradox”. In this study there was a decline in the prevalence of all traditional risk factors but the prevalence of obesity was increased. The increase in obesity combined with the decrease of the total number of cases with CAD during crisis could be a direct confirmation of the “obesity paradox”.

Tobacco use has been found to be reduced during period of economic downturn [28-30]. Our results seem to support this finding. Moreover, smoking was considered as the strongest predictive factor for CAD before financial crisis, but not during crisis. Hence, it seems that economic downturn along with tobacco control legislations that were enforced since 2010 in Greece led people to make healthier lifestyle choices such as smoking cessation.

Last but not least, DM is associated with two to four-fold increased risk for multivessel CAD and worse overall long-term prognosis even though after PCI [31-34]. Moreover, there is also evidence that low income is related to higher incidence of DM [35, 36]. Nevertheless, in the current study the prevalence of diabetes remained stable during financial crisis. This finding might be consistent with the decreased percentage of patients with multivessel CAD. Poor nutrition and

decreased adherence to medication along with poor monitoring of diabetic complications during crisis could explain the stable prevalence of DM.

Limitations

The present study had several limitations. First, it was a retrospective single center study including patients who underwent diagnostic cardiac catheterization. Our cath lab is located in Athens and the patients admitted to our clinic were mostly Greek natives with similar economic and social status. Second, the study population was not propensity matched. Third, there were no follow up data.

Table 1. Demographic and clinical characteristics of study population before and during financial crisis.

	Total population (n=3895)	**Before crisis 2006 - 2007** (n=1228)	**During crisis 2011 - 2015** (n=2667)	**p-value**
Age (yrs)	63.8±11.3	63.8±10.6	63.9±11.6	0.78
Males (%)	74.2	76.4	73.3	0.04
Females (%)	25.8	23.6	26.7	0.04
Weight (kg)	81.1±15.5	80.3±13.7	81.6±16.5	0.01
Height (cm)	169.5±8.5	169.2±8.4	169.7±8.5	0.08
BMI (kg/m^2)	28.1±4.6	27.9±4.0	28.2±4.9	0.04
Risk factors				
Family history (%)	14.5	17.7	13	<0.001
Smoking (%)	39.6	45.4	36.9	<0.001
Hypertension (%)	62.9	69.2	60	<0.001
Dyslipidemia (%)	51.5	59	48.1	<0.001
Diabetes mellitus (%)	27.6	28.4	27.2	0.44
Obesity (%)	29.5	26.3	31.4	0.002
ACS (%)	41.6	45.5	39.9	<0.001

ACS: acute coronary syndrome, BMI: body mass index

Table 2. Demographic and clinical characteristics of CAD-positive and CAD-negative patients before and during financial crisis.

Risk factors	Before crisis 2006 - 2007 (n=1228)		During crisis 2011 - 2015 (n=2667)		p-values * (p_1, p_2)
	CAD (-)	CAD (+)	CAD (-)	CAD (+)	
Age (yrs)	61.7±11.6	64.4±10.2†	61.8±12.0	65.0±12.2†	0.9, 0.2
Gender (%, males)	61.9	80.9†	60.4	80.2†	0.7, 0.6
BMI (kg/m^2)	28.0±4.3	27.9±3.9	28.5±5.2	28.1±4.7	0.01, 0.3
Family history (%)	14.4	18.7	12.8	13.1	0.5, <0.001
Smoking (%)	31.6	49.6†	32.8	39.1†	0.7, <0.001
Hypertension (%)	63.6	71.0†	58.1	61	0.09, <0.001
Dyslipidemia (%)	39.9	64.9	36.2	54.6†	0.3, <0.001
Diabetes mellitus (%)	18.2	31.6	20.5	30.9†	0.4, 0.7
Obesity (%)	25.4	26.6	33.6	30.4	0.01, 0.05

BMI: body mass index, CAD: coronary artery disease

† significant difference (p<0.01) between positive versus negative CAD

* p-values (p_1, p_2) indicate significant (p<0.01) differences for subjects without CAD (-) and those with CAD (+), between the two periods (2006-2007 vs 2011-2015), respectively.

Table 3. Angiographic characteristics of study population before and during financial crisis.

	Before crisis 2006 - 2007 (n=1228)	**During crisis 2011 - 2015** (n=2667)	**p-value**
Without CAD (%)	23.7	35.1	<0.001
1-vessel disease (%)	20.5	23.0	
2-vessels disease (%)	20.2	18.9	
3-vessels disease (%)	35.6	23.0	
Diseased vessel			
LAD (%)	63.5	49.4	<0.001
LCX (%)	49.3	38.7	
RCA (%)	54.6	41.4	
LM (%)	11.0	6.1	
Number of stented vessels	0.2±0.4	0.3±0.6	<0.001
0-vessel (%)	84.8	78.1	
1-vessel (%)	12.5	15.9	
2-vessels (%)	2.7	4.8	
3-vessels (%)	0	1.1	

CAD: coronary artery disease, LAD: left anterior descending artery, LCX: left circumflex artery, LM: left main, RCA: right coronary artery

Table 4. Multivariable analysis of the predictive value of each risk factor for CAD before and during financial crisis.

Risk factors	Before crisis 2006-2007		During crisis 2011-2015	
	Odds Ratio (95% Confidence intervals)	p-values	Odds Ratio (95% Confidence Intervals)	p-values
Age (yrs)	1.053 (1.04-1.07)	<0.001	1.037 (1.02-1.05)	<0.001
Gender (males)	2.771 (1.97-3.89)	<0.001	3.772 (2.68-5.30)	<0.001
Family history	1.826 (1.20-2.79)	0.005	1.832 (1.16-2.89)	0.01
Smoking	3.619 (2.51-5.21)	<0.001	1.191 (0.85-1.66)	0.3
Hypertension	1.669 (1.19-2.33)	0.003	0.884 (0.63-1.24)	0.5
Dyslipidemia	3.386 (2.50-4.59)	<0.001	3.110 (2.26-4.28)	<0.001
Diabetes mellitus	2.234 (1.54-3.23)	<0.001	1.744 (1.21-2.51)	0.003
Obesity	0.924 (0.65-1.31)	0.6	0.833 (0.59-1.17)	0.3

CAD: coronary artery disease

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